Physics 311

Homework Set 4

1. Consider four point charges located at the corners of a square with charges and coordinates

$$q_1 = q \ @ \ x = y = 0 \qquad , \qquad q_2 = 2q \ @ \ x = \ell \ , \ y = 0$$
$$q_3 = -q \ @ \ x = y = \ell \qquad , \qquad q_4 = 3q \ @ \ x = 0 \ , \ y = \ell \tag{1}$$

   a) Draw a diagram showing the position of each of the charges.

   b) On the diagram, show the the direction of the force acting on q_1 due to q_2; due to q_3; due to q_4.

   c) Calculate the the net force on q_1 due to the other charges in unit-vector notation.

2. a) Find the net charge on a solid sphere of radius R with a volume charge density

$$\rho(\theta) = \rho_0 \cos^2 \theta. \tag{2}$$

   b) Find the net charge on a circular plate of radius R with a surface charge density

$$\sigma(s) = \sigma_0 \frac{R}{s}. \tag{3}$$

3. Problem 2.3

4. Find the electric field a distance z above one end of a straight line segment of length L, which carries a non-uniform line charge density

$$\lambda(x) = \lambda_0 \frac{x^2}{L^2}. \tag{4}$$

5. Problem 2.6

6. Find the electric field a distance z above the center of a flat circular disk of radius R, which carries a non-uniform surface charge density

$$\sigma(s) = \sigma_0 \frac{s}{R} \tag{5}$$

7. Suppose the electric field in some region is found to be

$$\vec{E} = kr^5\hat{r}, \tag{6}$$

in spherical-polar coordinates, where k is a constant.

a) Find the charge density ρ.

b) Find the total charge contained in a sphere of radius R, centered at the origin. (Do it two different ways.)